Open Windows of Europe

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Abstract
The future of the transport sector is fraught with uncertainties, as the system is influenced by many factors. The aim of this paper is to offer insight into the future of this sector, seen from a European perspective, by applying a scenario approach and designing four possible paths of development. These future developments are presented here by a sketch of four contrasting European images based on the results of earlier research. The outcome for the transport sector, expressed in volumes for both passenger and freight, are qualitatively described and based on expected developments of several relevant indicators. Subsequently, the results are presented in terms of CO_2 emissions, with major focus on the EU. With these results in mind, it is interesting to confront the EU's objectives and current policies. Creating sustainable mobility appeared to be a key element in EU transport policy. Nevertheless, the achievement of sustainable mobility based on the results presented in this paper may seem problematic and will face several hurdles. But policy changes and (unexpected) technology developments may offer new possibilities to achieve a steadier development of the transport sector.

1 Introduction

An efficient transport system is a crucial precondition for economic development and an asset for local, regional and international mobility. The mobility of passengers and free transport of goods is considered an important element for a modern society. Transport has become a major economic sector with the integration of the world market, economic growth and higher levels of income. This can be illustrated, for example, by the contribution of the transport sector to the GDP. This figure is estimated at around 7 percent for Europe, and 8 percent in The Netherlands (Geerlings, 1997). This gives an indication of the importance of transport. The significance of this sector may even exceed these proportions, as no economic activity can flourish without transportation. It is clear that mobility has become a prerequisite for the proper functioning of modem societies.

The transport sector is subject to drastic changes and various trends. In the nearby future, changes in modal split and growth in mobility will have a direct impact on it. The role of transport policies will be another influencing factor. The increasing attention to market incentives and the move towards harmonization (a recent policy trend of the European Union) are aspects that may have a significant impact on this development. So the future of the transport sector is fraught with uncertainties, as the system could be influenced by many factors which could develop in various ways.

The aim of this paper is to gain insight into the future developments in the transportation sector up until 2020, seen from a European perspective. This is achieved by designing four paths of development for the transportation sector. We start out with four

globalization scenarios, constructed in an earlier phase of our research*. These globalization developments will form the input for the transport scenarios, which are elaborated on a European scale. The mentioned globalization scenarios were first qualitatively described and then quantified with the help of the Worldscan model of the CPB (see CPB, 1999). The results of the assessment are used as a guiding tool. The consequences of the scenarios will be expressed in clear numbers of transported volumes in 2020 (in ton-kilometers for freight and passenger-kilometers for passenger transport). This enables us to obtain more insight into the size of transport flows in order to estimate future transport emissions. This is an extremely important challenge, as all European countries have committed themselves to the Kyoto agreement in order to drastically cut CO_2 emissions. Thus, the achievement of sustainable transport is a major policy objective, and an exploration of alternative futures is crucial.

This paper is organized as follows. The next section will deal with general remarks concerning scenarios in the decision-making process. Section 3 gives a theoretical overview of the construction of scenarios and will describe certain types of scenarios as well as the possibilities in scale and time. The fourth section provides an overview of the European setting and the expected developments on a European scale, before describing consequences for future developments in European transport, based on four qualitative European scenarios. The subsequent section will show the consequences of the European scenarios in relation to the European sustainability policy. Conclusions are drawn in Section 6.

2 Scenarios in decision-making

Scenarios are descriptions of future developments founded on explicit assumptions that could have an important role in the decision-making process. Decision-making relies heavily on information that can be provided by scenarios. In general, existing information is not enough: it often does not fulfil the needs of decision-makers, neither in a quantitative nor a qualitative sense (Rienstra, 1998). This causes uncertainty about the likelihood of future developments.

The transport system is such an open system that uncertainty always exists. The system cannot be fully controlled but is subject to many factors. Therefore it is difficult to predict which developments in these systems are likely to occur in the future. This uncertainty can be reduced in various ways. For example, decision-makers have decision-support tools at their disposal. One of these tools are scenarios, which have the following functions (see e.g. Steenbergen, 1983):

- The signaling function: scenarios provide greater insight into uncertain situations.
- The communications and learning function: scenarios stimulate thoughts about alternative futures and provide decision-makers with options.
- The legitimization function: scenarios mobilize people and start processes of change when they show the impact if nothing is done, or when the future situation in the scenario seems beneficial.
- The exploring and explaining function: scenarios show how solutions for specific problems may become reality, given certain policy priorities.
- The demonstration function: scenarios show the consequences of specific decisions.

Scenarios enable us to reduce complexity and facilitate discussions about future events by arranging and classifying information and preventing information overload (Rienstra, 1998). Scenarios may help in gaining insight into the consequences of strategies and help to compare the consequences of the choice for a certain strategy. Scenarios in this way can provide us with new insights into possible paths and policies and their impacts on the future.

[1] Globalization, International Transport and the Global Environment (GITAGE), writing transport scenarios is one of the tasks of this project funded by NWO, see also van Veen-Groot et al., 1998.

It should be noted that scenarios could be constructed in various ways, using different methods, and leading to different contents. They may be intuitive or a literary product, idealistic or based on qualitative assessment. Scenarios are structured brainstorming methods created to widen the perceptions of policy makers and researchers regarding future possibilities and policy options.

Transport has a strategic role in most economies and is an important tool for politicians and governments in stimulating economic growth. Governments use transport to gain or increase competitive advantage on other countries. Nevertheless, transport has a lot of negative consequences such as the external impact on the environment. Since there are often conflicting interests in the field of (future) transport, scenarios can provide the tool for coming to solid future expectations/descriptions.

3 Transport scenarios

We have described the importance of scenarios in decision making. The scenarios describe future expectations in the field of transport, divided into expectations for freight and passenger transport. Transport refers to the movement of people, information and goods and has become one of the key activities in modem society. Transport scenarios are seen here as pictures of the future within the specified framework of the movement of goods and persons. The scenarios can be described on the basis of different characteristics of transport (e.g. volume, spatial organization, modal split, and transport technology, distance and emission factors). The construction of these scenarios will give insight into the future developments of the transportation sector. It is important to bear in mind that the foreseen developments in transport are directly derived from global developments as described in four globalization scenarios (Van Veen-Groot, et al., 1999). From this follows the distinction between two regions (OECD vs. non-OECD on a world scale), which also forced us to make a division on a European level (EU versus non-EU, see below).

This structure is followed through in the next sections, which describe the various transport scenarios. In order to describe changes in transport volume properly (used here as a characteristic to express changes in transport) four aspects of transport are described. Spatial organization, distance, technological development and modal split will all have a certain impact on transported volumes and can be seen as indicators. Each scenario will close with an overview (combined for spatial organization and distance, and excluding modal split) of (expected) impact on the various aspects on the modalities in Europe (EU (members of the European Union (+ Iceland, Norway and Switzerland) vs. non-EU) in table-form. These tables are filled with indicators (+, 0, -) expressing the expected impact on modalities of the various developments described in the scenarios. The situation as it was in 1995 was taken as a starting point: this is the reference situation. A plus in transport volume only means that it is expected that the volume of goods or persons transported by a certain mode will grow in comparison to the reference situation. As a consequence, double plus means that a stronger positive development is expected. It is important to keep in mind, however, that the plusses do not necessarily have the same meaning within the diverse aspects and scenarios, nor within a scenario. A plus for technology impact on transport volume is not comparable with a plus for distance/spatial organization). They can only be regarded as indicators of a positive, a neutral or a negative development (in case of a minus). In the description here, a zero does not mean that the situation will not change during the period of time. It only indicates that compared to the reference situation, no significant change is to be expected.

3.1 Scenario 1: Growth

In this scenario, there are high economic growth rates in the EU as well as in non-EU countries. Production and consumption will take place on a European scale, which produces a

rise in transportation flows within Europe, as a result of the increasing demand of users for transport services. The non-EU countries should open up to allow foreign goods and foreign investment. By opening up, the dissemination of technologies from Western Europe will be accelerated in non-EU countries. Eastern Europe benefits from the overflow from Western Europe to come to economic prosperity. The EU and non-EU countries will grow towards each other and closer economic integration between rich and poor countries will result. Finally, the distinction between non-EU and EU will become weaker and expansion of the EU will become realistic.

Because of the 'Europeanization' of production and consumption, it is likely that the average distance covered by the diverse transport modes will increase. The economic growth in non-EU countries will lead to a convergence of consumer preferences towards the EU (CPB, 1999). This increase in transport applies not only to passenger transport, but also to freight transport.

The progress of new transportation technologies in combination with high economic growth rates will cause an increase in mobility and transport throughout Europe. The national governments want to stimulate economic growth. Transport is assumed to be necessary to accomplish this, so public infrastructure for the diverse transport modes will have to be constructed. This scenario predicts a considerable growth in international air and high-speed rail transport. Especially the introduction and expansion of high-speed rail will have its impact and will cause a shift between the diverse transport modes. The future of road transport is somewhat unsure, however. There are improvements to be expected concerning fuel and engine technologies, but these will not have a significant impact on the use of the car as a means of transport. This will just reduce negative impacts on the environment in a modest way. There will also be a trend towards intermodal transport. Because of the growing volume of transport flows, other/new transportation systems will be used to transport larger quantities of goods and to cover the new routes, as well as reach new destinations. The European mainports, which will support this trend, will have the latest transport technology at their disposal.

As a result of the prosperous economic situation in Europe, the more expensive (but faster) transport modes will become more generally used. For passenger transport, this means that air and high-speed rail transport will be more widely used, and will form a substitute for road transportation. The main part of this shift in modality will take place in Western Europe, where the means to develop and to enlarge such a system are more easily available than in Eastern Europe. For freight transportation, an increase in performance is to be expected, since current performance is rather low, and with the progress in transport technology, freight transport by rail will benefit from this development.

In response to the liberalization of goods markets and lower transport costs (CPB, 1999), international specialization becomes more pronounced This, together with the trend towards 'Europeanization', will lead to increased flows in freight transportation. In passenger transport, growth also is foreseen. Due to the rise in income, people will make more trips for consumption reasons, including leisure and shopping. The growth in consumption as well as the growth in production will lead to increased transport volume. More people have to travel to work, education and training. The former mentioned technology might reduce this trend, but to a lesser extent.

Trans European Networks (TEN's) will play an important role in this scenario. The development of the TEN's will influence the spatial organization in Europe. As a result of these networks, transport flows will concentrate on specific infrastructures. Such networks will not only occur in road transport but will be developed for rail transportation as well. As a consequence, transfer points in these networks will develop into large mainports. High-speed networks for rail transport will especially be implemented in the EU countries where they

have the latest transport technology at their disposal. The nodes in the TEN's will become the focal points of economic growth, production and population.

TABLE 1: Scenario 1: Growth

		Spatial organization/ Distance		Transport technology		Volume	
		EU	Non-EU	EU	Non-EU	EU	Non-EU
Freight transport	Air	+	+	+	+	+	+
	Road	+	++	+	++	++	++
	Rail	++	+	+	++	+	++
	Seaborne shipping	+	+	+	+	++	+
	Inland shipping	+	+	+	+	+	+
Pass transp	Air	+	+	+	+	+	++
	Road	+	++	+	++	+	++
	Rail	++	++	++	++	++	++

3.2 Scenario 2: Core-growth

This scenario assumes that governments in Eastern European countries are not able to pursue market oriented and outward oriented policies. The political situation in most of these countries is unstable and leads to an introspective attitude. This is in contrast to the development of the EU where high economic progress exists. The prosperous economic situation in the EU countries is combined with high technological progress and intensive trade with the rest of the world. The expectation that the EU will be enlarged with other countries is unlikely.

In order to control this economic growth and to retain its competitive position in the world, a strong European Union is to be expected. Economic efficiency in the transport sector will be enhanced and economic development stimulated. The EU will succeed in reducing the missing links; for example, the Trans-European networks will be completed. Apart from efficiency goals, new infrastructure links are also being built to ensure cohesion in the EU space (equity). As the Eastern European countries are inward oriented and unwilling to participate they will not be enclosed in these networks. Policies will aim to equalize economic activities, welfare and population over the EU, which will largely be achieved by expanding EU cohesion and regional development funds. Trade and transport will be concentrated within the EU countries.

Road networks will not be the first priority; as a result of the sustainability objective, harbors are far more important. Airports will expand in the booming regions, because air transport will be far more efficiently organized (especially within the EU). They will mainly facilitate intercontinental transport. Consequently, harbors and mainports will become crucial. They will act as intercontinental, national and regional points of transhipment where different transport modes meet up. Locations where air and rail meet are also becoming significant. Economic activities will take place in and around these major locations and new techniques will be used to support the development of these transfer points. The development of networks in Eastern Europe lags behind and there is no real concentration of spatial activities. There is a lack of network infrastructure and mainports remain underdeveloped, mainly due to the inward orientation of government policies.

The distances over which goods and passengers have to be transported will increase within the EU countries. The kilometers covered by air transport will show the fastest growth in freight transport, followed by the kilometers covered by rail transportation of passengers. The distance covered by road transport is growing too, but to a lesser degree because of the technological development of other logistics in commuter transport. Physical distance will

become less important because of improved telecommunication technologies. In Eastern European countries, however, road transport will flourish as a result of the lack of other innovative transportation.

The technological progress is one of the driving factors behind the economic growth in EU countries. New (transportation) technologies will be developed and applied fairly soon. Especially air and rail technologies will improve in these sectors and become more important within the EU. New (ICT) techniques will facilitate the efficient operation of high-speed rail networks. Air transportation, in turn, will improve in efficiency because of new radar systems and improved communications. Technical developments will also take place in the motor car system but to a lesser degree, and will solely relate to a lower consumption of fuel. Electric cars will improve, but a major breakthrough is not anticipated.

Eastern European countries will increasingly rely on already existing techniques. Slowly certain new techniques will be imported from other countries but on a small scale. The techniques will be implemented first in those sectors where innovation is strong in European Union countries (e.g. air and rail).

It is obvious that as a result of economic growth, the more expensive (but faster) travel/transportation modes will become serious options for a wider public. For passenger transport, this means that intercontinental air transport and high-speed rail transport will become more popular compared to road transport. Freight will be organized more traditionally in the EU; road networks will remain dominant, although inland waterways will take over a considerable share. In terms of long distance freight transport, sea shipping and air transport will become dominant, supported by the development of networks and mainports.

Eastern Europe, on the other hand, has no flourishing trade. Governments do not stimulate investment in infrastructure. As a result these non-EU countries will rely on already available transportation modes and related techniques. Road transport is still the dominant mode of passenger and freight transport in developing countries.

The demand for transport is paramount in the economic progress of EU countries. It is obvious that this leads to increased flows in freight and passenger transportation. Developments in the general economic situation, spatial organization, technology and modal split will lead to changes in volume. Eastern European countries will still be mainly dependent on road transport as no important new developments are expected. As a result, this will have an impact on transport volumes.

TABLE 2: Scenario 2: Core-Growth

		Spatial organization/ Distance		**Transport technology**		**Volume**	
		EU	Non-EU	EU	Non-EU	EU	Non-EU
Freight transport	Air	++	0	++	+	++	+
	Road	+	+	+	0	+	+
	Rail	+	0	++	+	+	0
	Seaborne shipping	++	+	++	+	++	+
	Inland shipping	+	0	+	0	++	0
Pass transp	Air	+	0	++	+	+	0
	Road	+	+	+	0	++	+
	Rail	++	0	++	0	++	0

3.3 Scenario 3: Peripheral growth

In the first two scenarios, a rosy picture of the EU countries was described. They benefited from external factors such as the economic growth in non-EU countries, or they themselves generated high economic growth rates. In this scenario, however, the emphasis will be on

Eastern Europe (the non-EU countries). The European Union did not manage to generate important technology breakthroughs, which enabled Eastern Europe to make up on arrears on the basis of existing conventional technologies. This means that mainly the energy-intensive technologies from the EU countries will be copied, due to the lack of energy-extensive innovations in non-EU countries. As a result, the demand for energy will rise substantially, resulting in an increase of emissions (van Veen-Groot, 1999).

The EU countries will face a drop in economic growth, caused by a limited availability of resources and a slow-down in the progress of technological development (van Veen-Groot, 1999). Economic crises in the EU will strengthen protectionist sentiments and slow down international trade. The Eastern European trade blocks will make sure that the main point of trade and transport will shift from the EU towards Eastern Europe. As the main transport flows are found in these regions, this will result in an increase in emissions. Nevertheless, the non-EU countries will start to develop networks that connect Eastern European countries, enabling them to meet the growing demand for goods and transport.

The average distance covered by the diverse transport modes will increase in Eastern Europe, thanks to the prosperous economy and growing trade (not only regional, but also international). In Western Europe, the growth will be lower, due to the unstable economic situation. As a result of the strong economic growth in Eastern Europe, the demand for goods and the demand for passenger transportation will rise.

New technologies will not be invented because of the restrained economic situation in the EU. Non-EU countries will copy existing innovations and technologies from the EU before they introduce their own. This means that new transportation technologies are not to be expected. Among the latest technologies from Western Europe, the biggest improvements are to be found in road transportation. The attention of the non-EU countries will mainly be on bigger and more luxurious road vehicles, which will have a negative influence on the environment. Improvements in air transportation are also to be expected, mainly because of the updating of current fleets to further ensure the safety of passengers. In rail transportation, there will be a change from fuel trains to electric trains.

Some major changes in modal split are to be foreseen. In Eastern Europe, the more expensive and faster travel modes will become available to a wider public. This means that a modal shift will take place from road passenger transport to rail, and especially air transport. Major investments are being made in rail infrastructure, so that trains can use double instead of single tracks. This will produce an increase in the number of passengers, since travelling by train is becoming far more convenient and efficient. Nevertheless, the main growth is to be expected in road transport, which is still the transport mode with the most capacity and the lowest costs. It is also the mode that requires the least effort in expanding, and meets the growing demand for the transportation of goods and passengers. Western European countries will show a medium growth in air and shipping because of the strong prevailing trend towards these transport systems, and the lower tendency towards road transport.

Due to the economic situation in Eastern Europe, the demand for goods will rise. Consumers in non-EU countries will change their consumption patterns in line with that of EU countries. This means that more goods will have to be transported, most likely over larger distances and the volume of transported goods will rise. In Eastern Europe, passenger transport is likely to increase as well. In Western Europe, the volume of transport flows will stay more or less equal, although some growth in air and sea transport is expected. Due to the unstable economic situation, a substantial growth in demand for goods and passenger transportation is not foreseen.

TABLE 3: Scenario 3: Peripheral Growth

		Spatial organization/ Distance		Transport technology		Volume	
		EU	Non-EU	EU	Non-EU	EU	Non-EU
Freight transport	Air	0	++	0	++	+	++
	Road	+	++	+	++	0	++
	Rail	0	+	0	++	0	+
	Seaborne shipping	+	+	+	+	+	+
	Inland shipping	+	+	+	+	0	+
Pass trans	Air	0	++	0	++	+	++
	Road	+	++	+	++	0	+
	Rail	0	+	0	++	0	++

3.4 Scenario 4: Sustainable growth

The previous scenarios all took the level of economic growth as a starting point, and the environment was a minor aspect. In contrast, this scenario concentrates on the environment. Environmental quality within Europe is regarded as the driving force. Economic growth is not neglected but is only important within the constraints of wellbeing and (environmental) quality of life. Society as a whole is aware of the need to create and enhance a sustainable development.

Production and consumption will be more local but continue to take place in the EU more than in non-EU countries. While local transport between regions will predominate, development of the European-wide road networks will stagnate. Trains will take over long distance travel. Points of transfer will increase as multimodal and collective transport grows. Especially rail/sea and air/sea movement will grow. Seen from this perspective, harbors and mainports will largely affect the efficiency of multimodal transport and are vital in this development.

Overall, on both sides of Europe, one can see that transport distances will remain stable and transport flows will be bundled. Air transport may retain its share, as it is mainly used for international travel and long distances. Within Europe, passenger rail transport will take over distances that were formerly covered by air transportation. For the passage of freight, the same holds true for inland and sea shipping. Road transport will also lose part of its share (more in passenger than in freight transport) because private transport will become more expensive.

This scenario foresees an important role for technological development in realizing a more sustainable society. All over Europe new transport technologies will be vital for a sustainable economic development. Growing environmental awareness will accelerate the acceptation of new, less polluting, applications. Large-scale investments in infrastructure will be made, and new techniques will be implemented and mostly directed towards improvement of the energy efficiency of the various types of transport vehicles. The implementation of technological applications will be substantial: new IT possibilities, electric cars and new forms of public transport will become common. The EU will export its technology to Eastern European countries.

Innovations affecting road transport will be higher in Eastern Europe than in the EU as the latter already own cleaner cars and trucks. In the EU more attention will be paid to energy efficient techniques and the application of new telematics (e.g. dynamic route information) to increase capacity of existing infrastructure. The aviation sector will also improve. New airplanes will be introduced which will be fuelled with liquid hydrogen. Innovations in logistics will improve multimodal transport and give a push to the transportation of freight by rail and water. Railway and urban public transport will expand because of improved

technological developments and increasing capacity of existing infrastructures. Environmental awareness will also be expressed by growth in collective transport modes in both EU and non-EU countries. Individual transport will lose market share and become less important.

Although improvements are expected from the technology push in most polluting modes, it is still foreseen that rail, other public transport and shipment will claim a larger share in future. The use of public transport (improvements in service and infrastructure) will grow in densely populated areas and bigger cities. Also ICT will be implemented as a substitute for physical transport. The growth of air passenger transport will be limited because of the construction of subsidized HST tracks all over Europe. In order to save the environment and to overcome resistance from society, the HST is mainly using upgraded tracks. As for freight transport in Europe, seabome shipping will become more important as multimodal transport is carried out more efficiently and it is regarded as environmentally friendly. Inland shipping will grow as a result of an improved competitive position with regard to road transport.

The foregoing aspects will have an impact on the volume of transport flows. In this environmental scenario, transportation will change as it is generally seen as a significant contributor to the environmental problems in our current society. It is anticipated that technology will help in reducing these negative effects (which affect all modes) and create a shift towards cleaner ones. In the transportation of freight, it is expected that the aviation and the rail sectors will grow. This development is facilitated by the change in spatial organization (mainports) and new technologies aimed at improved logistics. Rail and public transport (collective modes) will largely substitute passenger transport. Again it will draw passengers from road transport, as individual transport is not attractive.

TABLE 4: Scenario 4: Sustainable Growth

		Spatial organization/ Distance		**Transport technology**		**Volume**	
		EU	Non-EU	EU	Non-EU	EU	Non-EU
Freight transport	Air	+	+	+	+	+	+
	Road	0	+	+	++	0	0
	Rail	+	+	+	+	+	+
	Seaborne shipping	+	+	++	+	++	+
	Inland shipping	+	+	++	++	++	++
Pass. transp	Air	+	+	+	+	0	+
	Road		0	+	++	0	0
	Rail	+	+	++	++	++	+

Overview

The description of the various scenarios in the previous sections ended with an overview of expected changes in transported volumes based on developments in transport technology, modal split and spatial organization/distance. The main outcomes are presented in Table 5, which provides a comparison of the four different European transportation scenarios.

TABLE 5: Summarization of scenarios

	Growth	Core-growth	Peripheral growth	Sustainable growth
Spatial organization	• *Europeanization of production and consumption* • *Concentration on mainports*	• *Importance of networks, harbors and mainports in EU* • *Concentration of trade and transport within EU*	• *Concentration of trade and transport within non-EU*	• *Localized production and consumption* • *Importance of harbors*

	• *Development of Trans European Networks*			
Distance	• *Increase of average distance*	• *Major increase of average distance within EU* • *Minor increase of average distance within non-EU*	• *Major increase of average distance within non-EU* • *Minor increase of average distance within EU*	• *Stabilization of average distance within Europe*
Transport technology	• *High progress of new transportation technologies* • *Terminal facilities will be improved* • *Innovations on management level: ICT facilities*	• *High progress of new transportation technologies, especially in air and rail for EU* • *Terminal facilities will be improved in EU* • *ICT will be booming*	• *Improvement in technology mainly in non-EU* • *Increase of the use of ICT in non-EU*	• *Increase of efficiency of traditional modes* • *More improvements than other scenarios*
Modal split	• *Growth of international air and high-speed rail transport* • *Increase of intermodal transport*	• *Increase of air transport* • *Rail mainly important within EU (high-speed)* • *Overall importance of road transport (but restrained; due to fair and efficient pricing)* • *Sea transport important for freight*	• *Fast growth of road, air and rail in non-EU* • *Medium growth of air and shipping in EU*	• *ICT is a substitute of physical transport* • *Use of seaborne shipping important* • *Less leisure transport (due to high prices)*

These developments will have consequences for the transported volumes in terms of ton-kilometers and passenger-kilometers. Based on a tentative weighting of the various developments (expressed in terms of plusses, minuses or no changes) relative changes in volumes are expressed (see Table 6 for a comparison of the four scenarios).

TABLE 6: Changes in European Volume

		Growth		**Core-growth**		**Peripheral growth**		**Sustainable growth**	
		EU	*non-EU*	*EU*	*non-EU*	*EU*	*non-EU*	*EU*	*non-EU*
Freight transport	Air	+	+	++	+	+	++	+	+
	Road	++	++	+	+	0	++	0	0
	Rail	+	++	+	0	0	+	+	+
	Seaborne shipping	++	+	++	+	+	+	++	+
	Inland shipping	+	+	++	0	0	+	++	++
Pass. transp	Air	+	++	+	0	+	++	0	+
	Road	+	++	+	+	0	+	0	0
	Rail	++	++	++	0	0	++	++	+

From this table it becomes clear that there are quite some differences between the developments in transport volumes in the different scenarios on a European level. In scenario 1, for example, all distinguished transport modes for both passenger and freight in the EU will

grow in terms of transported volumes. It might be clear that sustainable growth expects some particular modes to grow whereas road transport is likely not to show any difference compared with **1995.** Now that these changes are clear and insight into some future developments has been clarified, it is interesting to estimate what the consequences are in terms of emissions (CO_2). This will be done in the next sections with the focus on the EU.

4 Emissions for the European Union

Section 3 described the various scenarios in a detailed way, which resulted in identified changes in transported volumes with regard to the reference situation (1995). The main thought behind this presentation in volumes was related to the next phase: calculating the emissions. These transported volumes (in terms of ton-kilometers (concerning freight transport) and passenger-kilometers (concerning passenger transport) are a prerequisite to calculate the consequences in terms of emissions (the focus is here on CO_2 emissions). So quantitative data had to be obtained concerning transported volumes in 2020. This information, together with assumptions about the development of energy efficiency of the various modes, enables us to derive the expected CO_2 emissions of road transport for 2020 in the EU (including Norway, Iceland and Switzerland). In this section we will shortly discuss the method we used to obtain these emission figures. For more detailed information on the calculation of quantitative volumes, we refer to Nijkamp et al. (2000) and for the final emissions, we refer to Olsthoom (2000).

In an earlier section it was elucidated that the transport scenarios are derived from globalization scenarios. These global images were quantified by using the Worldscan model (see CPB, 1999). This resulted in growth rates between 1995 and 2020 for certain aspects such as GDP and real producer prices. These outcomes (especially trade and economic growth) enabled us to compose growth rates for transport in Europe for both passenger and freight transport. Taking the transported volumes in 1995 as a starting point, we can calculate the total transport volume in 2020. Further, the growth in this period is allocated over the various modes, distinguishing between passenger transport and freight transport (because of different unities). In allocating this growth the various changes in volumes, as presented in Table 6, are taken into account. This resulted in new volumes for each mode in each scenario. These volumes formed the input for the calculation of emissions. The CO_2 emissions were calculated based on several (energy efficiency) assumptions (Olsthoom, 2000).

Figure 1 gives an overview of the CO_2 emissions caused by the various modes for the reference year and the four scenarios. From this figure it becomes clear that road transport has the biggest share in the total emissions. Scenario 1 shows a relatively large growth in emissions compared to scenario 3 and 4. Scenario 4 does not differ that much from the situation in 1995, so even in an EU country with a strong environmental awareness, it is not likely that emissions will decrease in the next 20 years. It should be kept in mind though that the scenarios do not contain concrete transport policies. Various policy measures could steer the development in a more desired direction, which would affect the outcomes presented here. It might be clear that the results of scenario 1 (Growth) and 2 (Core growth) are incompatible with a sustainable development. It is therefor interesting to see what current EU transport policy encloses and what the expected impact on emissions is of these measures in relation to the objectives and the scenarios. The next section will deal with these aspects.

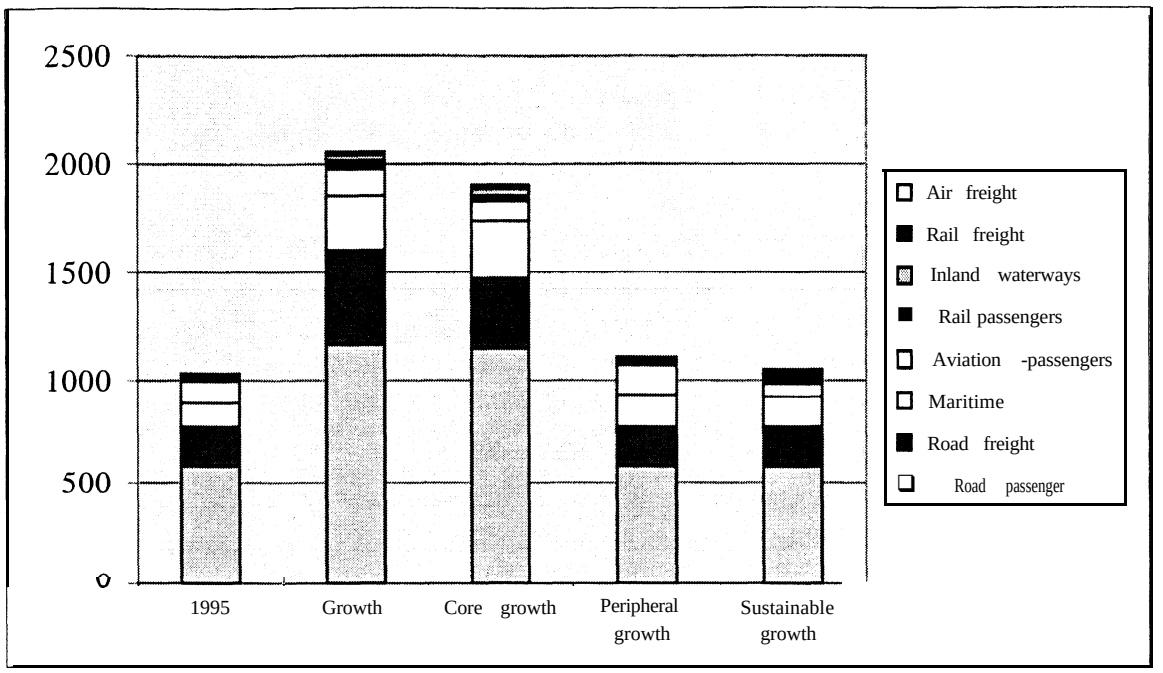

Figure 1: CO_2 emissions in the European Union (Gtonne)
Source: Olsthoom, 2000

5 European Transport Policy

Currently the European transport policy is known as the Common Transport Policy (CTP). EU transport policy was elaborated by the Commission in the 1992 white paper, entitled "The future development of the CTP" (CEC, 1992). This document suggested that future initiatives should focus on certain components, such as safety and environmental protection. The aim should be to move away from a single market based approach to a more comprehensive policy, designed to ensure the proper functioning of the transport systems. After this the strategy was further refined in 1995 when the Commission published its follow-up paper for a CTP action program. It stated that efficient, accessible and competitive transport systems are vital to the society and the economy of the Union. An update of this program has recently been published and aims at Sustainable Mobility (CEC, 1998). The completion of the single market, safety issues, environmental protection, fair and efficient pricing and economic and social cohesion will be the main priorities in the coming years until 2004. Sustainable mobility is the keyword in current policy within the EU. This means encouraging the development of efficient and environmentally friendly transport systems that are safe and socially acceptable. Looking to the future, the efficiency of transport systems remains a fundamental objective for the competitiveness of Europe and for growth and employment. This object must go hand in hand with the need to make transport more sustainable. In other words, the CTP must offer a framework for sustainable mobility. The Commission includes a list of policy initiatives to be taken. Some important initiatives in the context of emissions will be highlighted briefly:

- Environment: the Commission will strengthen its environmental assessment of policy initiatives with important environmental effects, especially in the light of CO_2 emissions and climatic change.
- Trans European Networks: encouragement to speed up the implementation of the priority projects defined at the Essen Summit.

- Fair and efficient pricing in transport: the Commission will take the necessary steps to apply progressively the principle of charging for marginal social costs. This means that transport users also have to pay for external costs such as congestion and noise.

This short description gives a good indication of the aim and scope of transport policy in Europe. It may be clear that the aim is to create a more sustainable transport system. Although discussion is possible on the explanation of sustainability in clear targets (weak and strong sustainability), it is imperative that the level of transport pollution should be curbed as much as possible. The level of CO_2 emissions, explicitly mentioned in the initiatives, is one of the key targets. From this it may be clear that the objective of the CTP is that the CO_2 emissions from transport will not grow and a decrease in emissions is even more desirable. In addition, a decrease is demanded by the Kyoto protocol (an 8% decrease of CO_2 emissions in 2010). If we look at the proposed outcomes of the various scenarios it is apparent that a decrease is not feasible without policy involvement. In fact, Scenarios 1 and 2 are even in contradiction to this desirable development, and show a strong increase.

This presents a major challenge for the European Union's transport policy based on the expected developments of the transport sector. In general two possibilities can be identified to meet this challenge of curbing CO_2 emissions by policy measures. Technological development (energy efficiency) can be stimulated and travel behavior can be steered in a more environmentally friendly direction. The implementation of fair and efficient pricing could be seen as a first step because environmental costs are included in prices. This will limit demand and probably create a modal shift towards more sustainable modes. However, it is doubtful whether the proposed initiatives are sufficient to reach the objectives in terms of emissions if we keep the various scenarios in mind. But policy changes and (unexpected) technological developments offer possibilities to achieve this objective.

6 Concluding Remarks

There is growing awareness that in the long term the development of society is characterized by substantial uncertainties. This often makes a prognosis-based approach inadequate. Scenario analysis is increasingly being used in long-range policy research, since it provides a way of identifying future issues and problems for policy making in an environment of qualitative uncertainty. Scenarios can be regarded as descriptions of possible futures that seem plausible under different sets of assumptions and provide a background against which policy assessments can be made. Scenarios are important tools for strategic policy analysis, especially in situations where policy makers have too much biased and unstructured information. The transport sector forms one of those fields where policy makers have to deal with many uncertainties as it is influenced by many factors. Despite these uncertainties, policy makers are faced with the objective of achieving sustainable mobility and need to have insight into future developments.

This paper presented possible future developments by sketching four European contrast images based on the outcome of earlier research. The outcome for the transport sector, expressed in transported volumes for both passenger and freight transport, was qualitatively described based on expected developments of several indicators. Developments in transport technology, spatial organization, distance and modals split have an impact on the transported volumes. This development was illustrated by indicators (+, 0, -) expressing the potential expected impact on modalities. This information formed the input for the calculation of CO_2 emissions with the focus on the EU. It appeared that for all four scenarios a decrease in emissions is not to be expected in 2020.

Sustainable mobility is central in current policy within the EU, this means the encouragement of the development of efficient and environmentally friendly transport

systems that are safe and socially acceptable. In terms of emissions this means that a decrease is aimed at and needed in order to meet the Kyoto norm. The achievement of this target (sustainable mobility) seems difficult based on the outcomes presented in this paper. Several policy initiatives are needed to reach this ambitious target. It is doubtful whether the proposed measures by the EU are sufficient to bring about this decoupling in economic growth and emissions. But the implementation of efficient policy measures and (unexpected) technology developments might offer possibilities to make a step towards a more sustainable direction. Policy makers are thus faced with formidable policy challenges to achieve the Kyoto objectives in the next 20 years.

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